Endoscopic Thermal Fasciotomy for Chronic Exertional Compartment Syndrome

Pramod B. Voleti, M.D., Drake G. Lebrun, B.S., Cameron A. Roth, B.S., and John D. Kelly IV, M.D.

Abstract: Chronic exertional compartment syndrome is an activity-induced condition that occurs when intracompartmental pressures within an osteofascial envelope increase during exercise, leading to reversible ischemic symptoms such as pain, cramping, numbness, or weakness. Nonoperative treatment options for this condition have shown limited success and are often undesirable for the patient given the requirement for activity modification. Traditional surgical treatment options involving open or subcutaneous fasciotomies have more favorable results, but these techniques are associated with significant morbidity. Endoscopically assisted fasciotomy techniques afford the advantages of being minimally invasive, providing excellent visualization, and allowing accelerated rehabilitation. The purpose of this article is to describe a technique for performing endoscopically assisted fasciotomies for chronic exertional compartment syndrome of the lower leg using an entirely endoscopic thermal ablating device. The endoscopic thermal fasciotomy technique is associated with minimal morbidity, ensures excellent hemostasis, and affords an early return to sports.

Chronic exertional compartment syndrome (CECS) is a debilitating activity-induced condition that may occur in recreational or competitive athletes. The syndrome is characterized by a supraphysiological increase in intracompartmental pressures during exercise, which results in decreased perfusion and symptoms of reversible ischemia, such as pain, cramping, numbness, or weakness. Symptoms typically persist until intracompartmental pressures decrease after cessation of activity. The syndrome is believed to be due to noncompliant osteofascial compartments that fail to respond to the increases in muscle volume that occur during exercise, thus resulting in increased intracompartmental pressures. It most commonly occurs in the lower leg but has also been described in the thigh, foot, and forearm.

CECS presents as recurrent episodes of pain that occur after increased activity and resolve with rest. Although a careful history and physical examination are important, the gold standard for diagnosis is measurement of intracompartmental pressures. According to Pedowitz et al., one or more of the following intracompartmental pressure criteria must be met for the diagnosis of CECS: (1) pre-exercise pressure of 15 mm Hg or greater, (2) 1-minute post-exercise pressure of 30 mm Hg or greater, or (3) 5-minute post-exercise pressure of 20 mm Hg or greater. Because the syndrome may affect 1 or more compartments of the lower leg, the clinician should always measure intracompartmental pressures in all 4 compartments to ensure an appropriate diagnosis.

The exact prevalence of CECS is unknown, but this syndrome has been shown to be the cause of 27% to 34% of cases of exercise-induced leg pain. CECS in the lower leg is often observed in athletes who engage in lower extremity-dominant sports, such as running or ball and puck sports. It often involves bilateral lower extremities and affects the anterior compartment of the leg more frequently than the lateral, deep posterior, and superficial posterior compartments. It occurs equally in male and female athletes.

Because CECS most commonly affects young athletes who enjoy an active lifestyle, treatment should focus on symptom control and return to activity. Nonoperative treatment options that focus on activity modification and stretching have been shown by some investigators to have limited success, with cessation of activity being the only consistent nonoperative means.
Surgical time
Because the procedure is endoscopic, the procedure is entirely endoscopic thermal ablating device (Table 1, Video 1). This technique provides excellent visualization, promoting enhanced hemostasis.

Surgical exposure
The dilator tip of the thermal ablating device should be advanced bluntly above the fascia for the entire length of the release to develop the tissue plane and enhance exposure.

Patient positioning
The patient is placed in the supine position with all bony prominences well padded and the contralateral lower extremity secured to the table. A pneumatic tourniquet is placed on the affected lower extremity.

Surgical exposure
The dilator tip of the thermal ablating device should be advanced bluntly above the fascia for the entire length of the release to develop the tissue plane and enhance exposure.

Protecting neurovascular structures
For the anterior compartment fasciotomy, the ablating device should stay adjacent to the anterior tibial cortex, thereby avoiding the superficial peroneal nerve. For the deep posterior compartment fasciotomy, the ablating device should stay adjacent to the posterior tibial cortex.

Surgical time
Because the procedure is endoscopic, fluid accumulates in the surrounding tissue, causing it to swell and limit visualization. We therefore recommend reducing the surgical time as much as possible by adhering to the steps described in this article.

of symptom resolution. Activity modification is often an unacceptable option for competitive athletes who are reluctant to change their exercise regimen or reduce their activity level. Therefore surgical management is considered the mainstay of treatment for these patients. Surgical treatment involves releasing the involved fascial compartments with fasciotomies. Previously described techniques include open fasciotomy, subcutaneous fasciotomy, and endoscopically assisted fasciotomy. Endoscopically assisted techniques typically involve sharp dissection (i.e., with long thoracic straight scissors) to release the fascial compartments, with bleeding and compromised visualization often being concerns. This study introduces a novel alternative endoscopically assisted technique that uses a thermal ablating instrument rather than sharp dissection, thus promoting enhanced hemostasis.

Fasciotomy generally yields good results, with multiple observational studies reporting successful outcomes (defined as pain relief and return to full activity) in most patients. Success rates vary by age, sex, and affected compartment but can range from 60% to 100%. Most patients can expect a return to full activity by 4 to 12 weeks. Comparison of outcomes is difficult because most studies on the subject have involved small sample sizes; specific patient populations (i.e., military personnel, elite athletes, or adolescents); and varying surgical indications, surgical techniques, and outcome measures. Patients with anterior or lateral exertional compartment syndrome tend to have better outcomes than patients with deep posterior exertional compartment syndrome. It has also been shown that women may respond less favorably than men to fasciotomy. This article will elaborate on our technique for performing fasciotomies for CECS of the lower leg using an entirely endoscopic thermal ablating device (Table 1, Video 1). This technique provides excellent visualization, promotes a bloodless field, and minimizes morbidity.

Technique
Under general anesthesia, the patient is placed in the supine position with all bony prominences well padded. The contralateral lower extremity is secured to the operative table. After placement of a pneumatic tourniquet, the affected lower extremity is prepared and draped in standard fashion. The lower leg is then exsanguinated with an Esmarch bandage, and the tourniquet is inflated to 300 mm Hg. The location of the tibial crest is marked for reference, and the intermuscular septum that divides the anterior and lateral compartments is palpated.

For the anterior compartment fasciotomy, a 1.5-cm longitudinal skin incision is marked just lateral to the tibial crest, centered over the proximal musculature. The incision is made with a No. 15 scalpel blade, and the dissection is bluntly carried down to the fascia (Fig 2A). The dilator tip of the ablating device is placed over the fascia of the affected compartment (Fig 2B). The muscle beneath the released fascia is then placed over the initial fascial incision and slowly advanced distally while coagulating so as to release the fascia (Fig 2B). The muscle beneath the released fascia will typically bulge through the opening created in the fascial layer. The fascial release is extended to approximately 3 fingerbreadths proximal to the lateral malleolus.

**Table 1. Tips and Pearls for Endoscopic Thermal Fasciotomy for Chronic Exertional Compartment Syndrome of Lower Leg**

<table>
<thead>
<tr>
<th>Step</th>
<th>Tips and Pearls</th>
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<tbody>
<tr>
<td>Patient selection</td>
<td>Diagnosis of chronic exertional compartment syndrome should be confirmed by measurement of intracompartmental pressures during exercise. The affected compartments should be noted.</td>
</tr>
<tr>
<td>Surgeon experience</td>
<td>Because our technique involves use of endoscopic guidance and instruments that are dissimilar to those used in standard arthroscopy, we recommend that surgeons practice on cadaveric specimens first.</td>
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For the deep posterior compartment fasciotomy, a 1.5-cm longitudinal skin incision is made with a No. 15 scalpel blade, approximately 2 fingerbreadths posterior to the tibial shaft and just distal to the tibial flare. Dissection is bluntly carried down to the fascial layer, the saphenous vein is identified and protected, and an initial fascial incision is made. Once again, under endoscopic guidance, the dilator tip of the thermal ablating device is advanced distally above the fascia for the entire length of the release to develop the tissue plane and enhance exposure. The ablating instrument is then placed over the initial fascial incision and slowly advanced distally while coagulating so as to release the fascia. The ablating device should hug the posterior tibial periosteum, thus ensuring release of the deep posterior compartment. The fascial release is advanced to approximately 3 fingerbreadths proximal to the medial malleolus.

Of note, neither the lateral nor the superficial posterior compartment is routinely released because Schepsis et al. found that no clinical benefit was conferred with the additional releases of these compartments. After performance of the fasciotomies, the incisions are irrigated thoroughly. The tourniquet is deflated, and hemostasis is achieved with electrocautery. Wound closure is performed with No. 2-0 Vicryl (Ethicon) for subcutaneous approximation and a running subcuticular Prolene skin suture (Ethicon). The procedure may be repeated for the contralateral lower extremity if indicated. Postoperatively, patients are allowed weight bearing as tolerated with crutches. They are permitted to return to sports approximately 4 to 6 weeks after surgery.

**Discussion**

CECS is an exercise-induced condition that can cause debilitating pain and loss of function. Nonoperative techniques for managing this condition have been largely unsuccessful, and traditional operative techniques using open or subcutaneous fasciotomies have associated morbidity. Endoscopic techniques have the advantage of being minimally invasive, thus allowing an early return to sports, while still providing excellent visualization of the fascia.

The aforementioned endoscopic thermal fasciotomy technique has shown positive results, with 80% of patients returning to their baseline level of activity and sports
participation with minimal pain at a mean of 7.2 weeks after surgery. These results compare favorably with series using conventional surgical techniques. Patients with CECS have traditionally been difficult to treat, with several associated morbidities potentially confounding successful treatment. The described technique is minimally invasive, provides excellent visualization, promotes a bloodless field, and minimizes morbidity. The senior author (J.D.K.) has successfully performed anterior releases with tourniquet times as low as 3 minutes. We hope that these favorable results will inspire further investigation into this novel minimally invasive technique for the treatment of CECS of the lower leg.

Of note, the lateral and superficial posterior compartments are not routinely released in the described technique. Schepsis et al. found that no clinical benefit was conferred with the additional releases of these compartments. The technique may be modified if fascial release of the lateral and superficial posterior compartments is warranted.

In conclusion, endoscopic thermal fasciotomy is a safe and effective procedure for the treatment of CECS of the lower leg. The technique is minimally invasive, ensures excellent hemostasis, and affords an early return to sports.

References

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